August 2000 • NREL/TP-620-28674

Technical Report

REPiS: The Renewable Electric Plant Information System

1999 Edition

K. Porter, D. Trickett, and L. Bird

National Renewable Energy Laboratory

1617 Cole Boulevard
Golden, Colorado 80401-3393

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Operated by Midwest Research Institute • Battelle • Bechtel

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Abstract

This technical report summarizes the data in the Renewable Electric Plant Information System (REPiS), a database of all known grid-connected renewable electric facilities in the United States. It was originally designed in 1985 and updated in 1990 and 1994 (Swezey and Porter 1988; Swezey and Porter 1990; Sinclair 1994). We discuss how the database is designed, and summarize some of the results of common search queries of the database. Data is presented on the amount of renewable electric capacity nationally that is operated, retired, planned or of unknown status, as well as operating and planned renewable electric capacity by state. We then compare the REPiS data to the 1994 edition of REPiS, and also to data published by the U.S. Energy Information Administration. We also note that electric restructuring will change how electric power data is collected and maintained; this may prompt some changes in future editions of REPiS. The REPiS database is available on the Internet at http://www.eren.doe.gov/repis.

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REPiS:
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Introduction

The Renewable Electric Plant Information System (REPiS) is a database of grid-connected renewable electric facilities, and is aimed at cataloging all known renewable electric facilities in the United States and making the data publicly available on an Internet site. The National Renewable Energy Laboratory (NREL) began the REPiS database in 1986. NREL has updated it periodically since then. The 1999 edition is the fourth update of REPiS. It represents a "best effort" at compiling an inventory of all known U.S. grid-connected renewable electric facilities through a large and systematic literature search. REPiS is a useful tool for researchers who want more detailed information on individual projects, renewable energy companies, or small renewable energy projects that are often overlooked in other databases. It will also benefit those who want to sort or manipulate data on renewable electric plants for their own individual research needs.

The REPiS database and common search queries are available on the Internet at http://www.eren.doe.gov/repis. Although every effort was made to determine the status of each entry in the database, there were several facilities for which the operating status could not be determined, and which are listed as unknown. We encourage those who have information on these projects, or with any other corrections or additions to REPiS, to contact the authors, or to send an e-mail at the Internet site.

This technical report presents some of the results from the REPiS database, and offers a perspective on how electric restructuring may affect electric power data collection, and therefore how future editions of REPiS could be conducted. Section II summarizes, in aggregate, data on the operational status by renewable energy technology. Section III breaks out the REPiS data by technology and discusses market trends over time for each technology, and some of the contributing policy and market factors. Section IV provides data on planned renewable energy units. Section V highlights the 10 states with the most renewable energy capacity and non-hydro renewable energy capacity, respectively. Section VI compares the data in this edition of REPiS with the 1994 edition of REPiS and with data on renewable electric technologies maintained by the U.S. Energy Information Administration (EIA). Section VII discusses how changes in data collection and availability, in response to electric industry restructuring, may affect future editions of REPiS. The report ends with a summary.

Aggregate Results

REPiS includes information on the following renewable energy technologies: biomass (agricultural waste, biogas, waste-to-energy [WTE] and wood residues); geothermal; small and large hydro (including pumped storage); photovoltaics (PV); solar thermal electric; and wind. REPiS contains information on 8,066 renewable energy plants that are grid-connected, and encompasses plants that are operating, planned, retired, in standby or testing, or where the status is unknown because of lack of information. Table 1 shows how operating status is defined in REPiS.

Table 1. Definitions of Plant Operating Status in REPiS

Plant Status	Definition
Operating	Unit is in operation and generating electricity.
Retired	Unit was in operation but has been removed from service because of age or economics.
Unknown	A unit may be operating or not operating, but the plant's operating status cannot be determined.
Planned	A unit is projected to be in operation at some future date. A planned unit is listed in REPiS if project plans have been announced through company press releases, trade press, and so on.
Cancelled	A unit previously listed as planned but is no longer expected to be in operation because of regulatory or economic considerations.
Out of Service	A unit normally in operation but has been removed from service for maintenance or repair.
Standby	A unit that supports a utility system and is available to replace or supplement a facility normally in service.
Testing	A new unit that is in testing and providing electric power to the grid but is not yet in commercial operation.

Renewable electric plants in REPiS may be sub-divided into units to reflect capacity additions over time to a specific renewable electric plant. For example, the 1,037-megawatt (MW) Hoover hydro plant in Nevada is listed as one plant and 14 units in REPiS, to show that the first unit was added in 1936 and the most recent unit was added in 1961. The 8,066 renewable electric plants are represented in 8,193 units, for an overall total of about 117,225 MW of renewable energy capacity. Of this, 6,819 units (about 83%) are currently operating, representing about 111,000 MW. Table 2 provides a breakdown by unit and plant status. REPiS also includes information on cancelled units, and these are identified separately in Table A-3 in Appendix A.

Table 2. Summary of Renewable Electric Plant, Units and Capacity (kilowatts [kW]) in REPiS, by Current Status

Status	No. of Plants	No. of Units	Capacity (kW)
Operating	6,730	6,819	111,027,155
Retired	734	760	2,517,866
Unknown	311	313	990,710
Planned	241	251	2,320,738
Out of Service	44	44	195,659
Standby	4	4	16,325
Testing	2	2	156,760
Total	8,066	8,193	117,225,213

Table 3 shows the installed capacity and status of each technology in REPiS. Hydro accounts for over 96 gigawatts (GW) of the 117 GW in REPiS. Pumped storage hydro accounts for 19.6 GW of the 96 GW of hydro in REPiS.

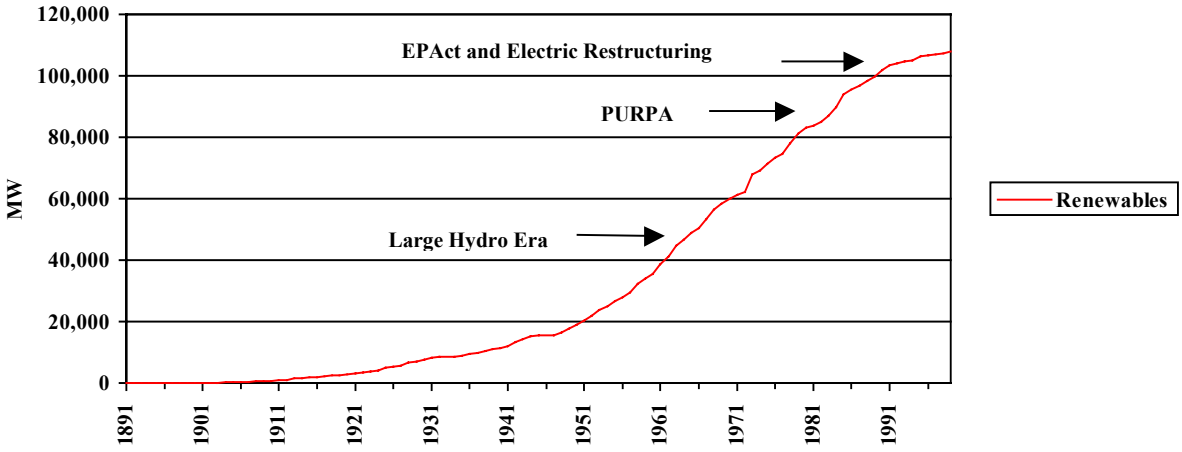
Table 3. Capacity and Operating Status by Technology (kW)

Fuel Source	Operating	Planned	Retired	Out of Service	Standby	Testing	Unknown Status	Total Capacity
Ag Waste	357,773	7,800	358,212				90	723,875
Biogas	1,063,949	195,896	67,825	4,618	7,200		4,425	1,343,913
Waste-to-Energy	2,563,038		476,898	1,200			72,550	3,113,686
Wood Residues	6,584,827	68,800	477,211		8,625		64,700	7,204,164
Total Biomass	10,569,588	272,496	1,380,146	9,818	15,825		141,765	12,385,638
Geothermal	2,697,150	225,499	398,120	55,000			272,000	3,647,769
Hydro*	94,789,367	579,910	414,362	109,624	500	156,760	406,243	96,456,766
Photovoltaics	15,432	66,773	7,562	3			117	89,886
Solar Thermal	353,925	2,000	15,575				8	371,508
Wind	2,601,694	1,174,060	302,100	25,214			170,578	4,273,647
Total	111,027,155	2,320,738	2,517,866	195,659	16,325	156,760	990,710	117,225,213

* Includes pumped storage hydro.

Figure 1 represents cumulative operating renewable energy capacity by year, and includes hydro and non-hydro renewable energy technologies. Renewable energy capacity remained relatively low until large hydro facilities were constructed, beginning in the 1940s. Large hydro continued to increase overall renewable energy capacity until the 1970s, when non-hydro renewable energy capacity started coming on-line in response to the Public Utility Regulatory Policies Act of 1978 (PURPA). Growth in renewable energy capacity began to slow in the 1990s, in part because of market uncertainties and greater competition from various state electric restructuring initiatives.

Figure 1. Cumulative Operating Renewable Energy Capacity by Year



Note: Figure 1 does not include 3,042 MW of operating renewable electric capacity in REPiS that does not have an identified on-line date.

Operating Renewable Electric Plants by Technology

Biomass

In REPiS, biomass encompasses agricultural residues, biogas, municipal solid waste, and wood residues. REPiS focuses on biomass electric technologies, but only about one-third of the 1,000 biomass-fired plants in the United States generate electricity for sale (Bain 1993). The rest are owned by the paper and wood-product industries for their own steam and electric needs. Table 4 presents the number of units and installed capacity for operating biomass electric plants, by fuel source.

Table 4. Operating Units and Capacity (kW) in REPiS of Biomass, by Fuel Source

Biomass Fuel Source	No. of Units	Capacity (kW)
Agricultural Waste	31	357,773
Biogas	263	1,063,949
Municipal Solid Waste	129	2,563,038
Wood Residues	312	6,584,827
Total	735	10,569,588

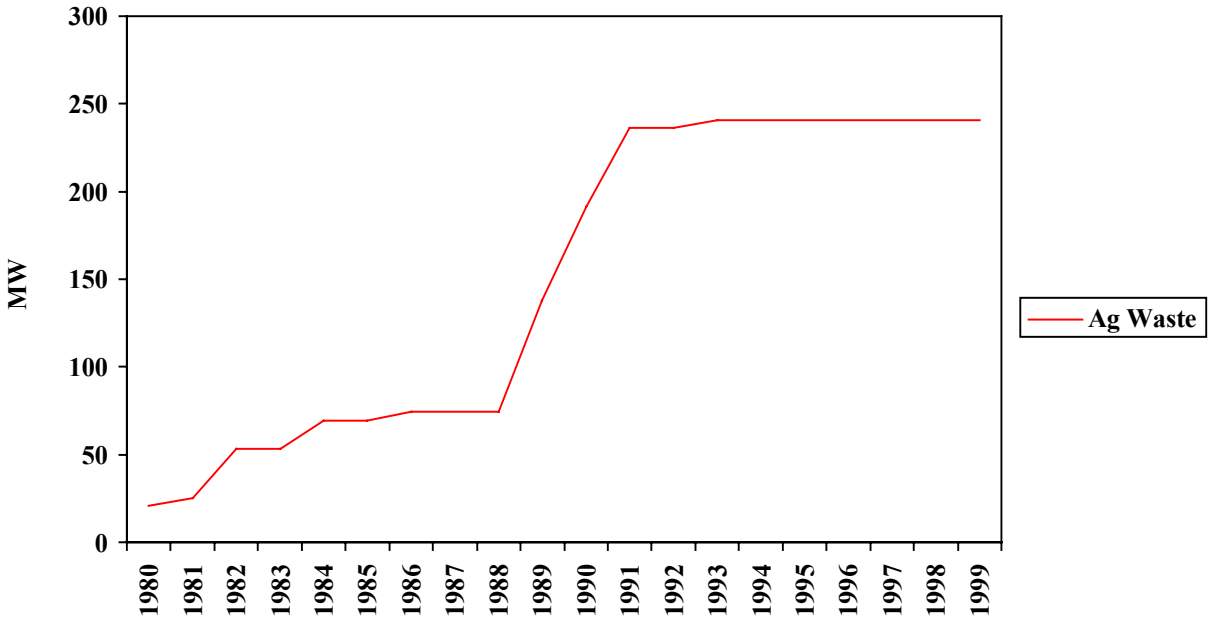
***Agricultural Waste**:* There are a total of 58 agricultural waste units in REPiS for a total capacity of 723 MW. Table 5 illustrates the status of this capacity.

Table 5. Summary of Agricultural Waste Capacity in REPiS, by Current Status

Status	No. of Units	Capacity (kW)
Operational	31	357,773
Retired	25	358,212
Planned	1	7,800
Unknown	1	90
Total	58	723,875

Agricultural waste facilities tend to come in two types: smaller (and typically older) plants tied to industrial or agricultural company operations, and newer and larger plants built for bulk power sales under PURPA. Agricultural waste facilities have been closing in great numbers in recent years, with 21 of the 25 retired facilities having gone out of operation since 1994. Electric utilities in California have bought out the contracts of some of these facilities, and some facilities closed because of operational problems. In Hawaii, sugar mill facilities were closed because of age and cost.

Figure 2. Cumulative Operating Agricultural Waste Capacity by Year



Note: Figure 2 does not include 117 MW of agricultural waste capacity in REPiS where the on-line date is unknown.

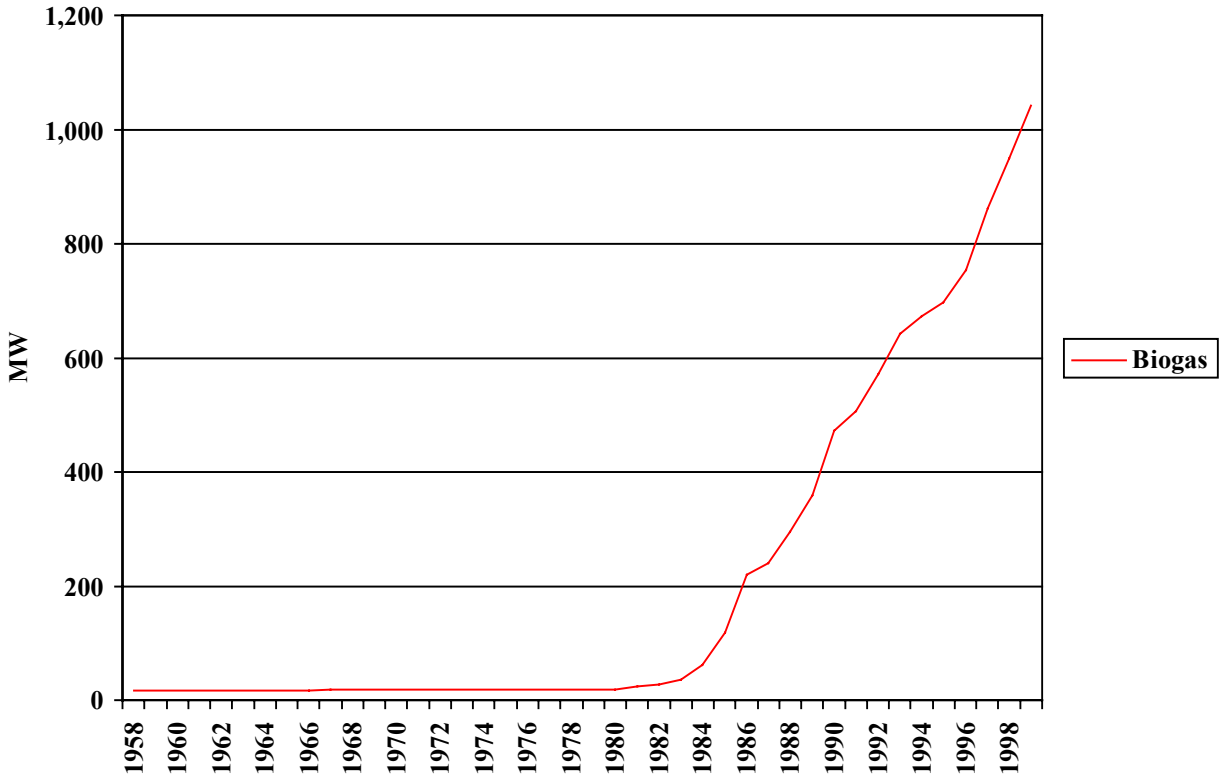
Biogas: Biogas is defined as collecting biomass-derived gas (such as methane from landfills) and generating electricity by combusting the gas in a reciprocating engine or gas turbine. Examples of biogas fuels include bagaase, anaerobic digestion, and landfill methane. REPiS includes 357 biogas units with a total capacity of 1,344 MW. Over 300 of the 357 units in REPiS are landfill methane facilities. Table 6 represents the status of biogas facilities.

Table 6. Summary of Biogas Capacity in REPiS, by Current Status

Status	No. of Units	Capacity (MW)
Operational	263	1,064
Retired	29	68
Planned	53	196
Unknown	7	4
Out of Service	4	5
Standby	1	7
Total	357	1,344

Biogas facilities are typically small—the average size of the units in REPiS is just over 3 MW. States with the greatest number of landfill methane facilities include California, Illinois, Michigan, New York, and Pennsylvania.

Figure 3. Cumulative Operating Biogas Capacity by Year



Note: Figure 3 does not include 22.445 MW of operating biogas capacity in REPiS that does not have an identified on-line date.

Landfill methane development has been driven primarily by the unconventional fuels tax credit passed as part of the Crude Oil Windfall Profits Tax of 1980. The Internal Revenue Service figured the credit annually by the price of a barrel of oil. According to some landfill gas developers, in terms of electricity production, the tax credit was worth up to 1.2 cents/kWh (Williams and Bateman 1995). The credit expired at the end of 1998 (Berenyi 1999a).

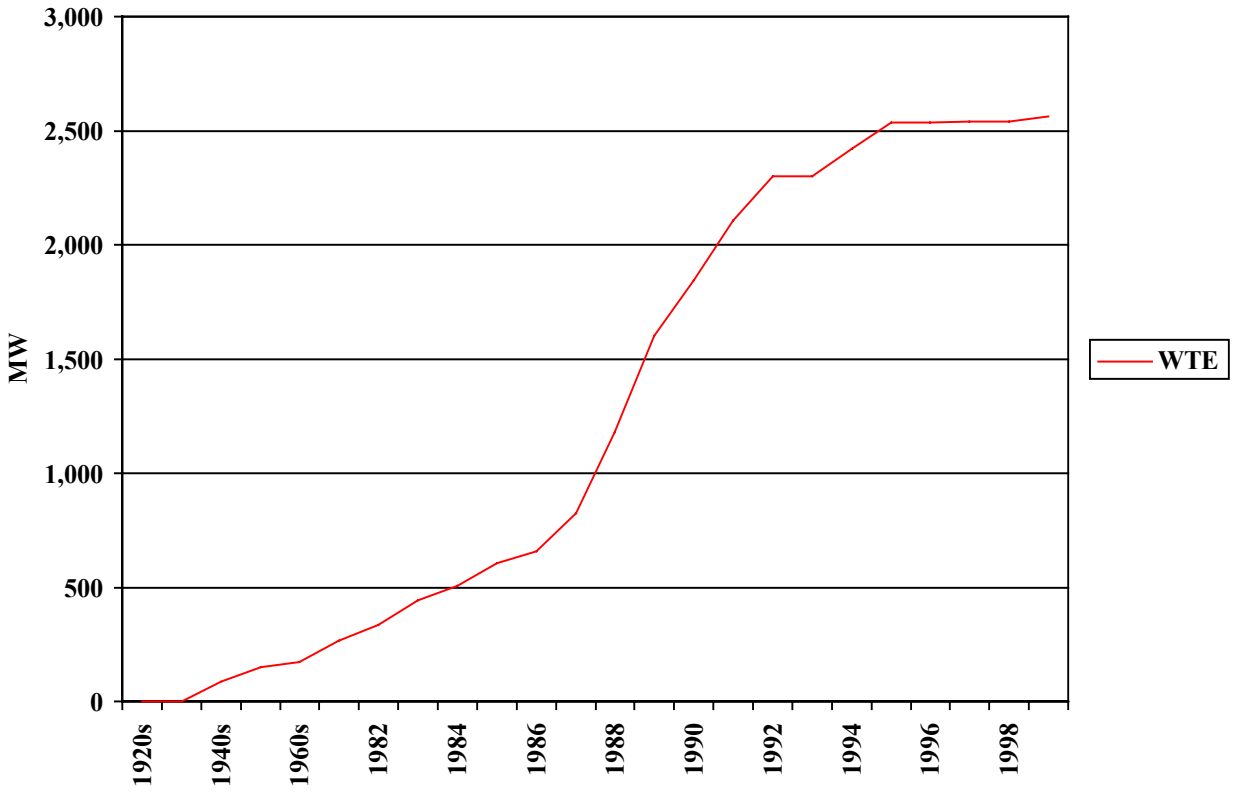
Waste-to-Energy: There are 168 waste-to-energy units in REPiS, with a total capacity of about 3,114 MW. Table 7 represents the status of (WTE) units.

Table 7. Summary of Waste-to-Energy Capacity in REPiS, by Current Status

Status	No. of Units	Capacity (kW)
Operational	129	2,563
Retired	34	477
Unknown	4	73
Out of Service	1	1
Total	168	3,114

Although the first waste-to-energy plants in the United States were built in the 1920s and 1930s, waste-to-energy experienced the biggest gain in the 1980s, when 72 units with a total capacity of 1,335 MW became operational. Market activity in that decade alone represents over 50% of capacity for all operating waste-to-energy facilities in REPiS. Like most of the other renewable energy technologies, waste-to-energy benefited from five-year accelerated depreciation, business energy tax credits, and power purchase contracts under PURPA. Waste-to-energy also was often eligible for tax-exempt municipal bond financing, which facilitated the construction of a number of municipal-owned waste-to-energy facilities.

Figure 4. Cumulative Operating Waste-to-Energy Capacity by Year



Market activity for waste-to-energy slowed precipitously in the 1990s because of the repeal of tax credits, lessened availability of power purchase contracts, sharper restrictions placed by Congress on the use of municipal tax-exempt bond financing in the 1986 Tax Reform Act, and increased public opposition to waste-to-energy facilities. In addition, a 1994 U.S. Supreme Court decision struck down the ability of municipal and county government to direct the flow of municipal solid waste towards municipal landfills or municipal waste-to-energy facilities, meaning waste-to-energy plants no longer had a predictable flow of waste and/or revenues to rely on. There were 33 waste-to-energy facilities that became operational in the 1990s that are still operating, for a total of 960 MW. Of these, only five came on-line after 1994. In addition, of the 34 waste-to-energy facilities in REPiS that are retired, 18 of these facilities, representing 395 MW, retired in the 1990s because of economic and/or operating problems.

***Wood Residues*:** There are 382 wood residue units in REPiS with a total capacity of over 7,204 MW. Table 8 represents the status of wood residue units.

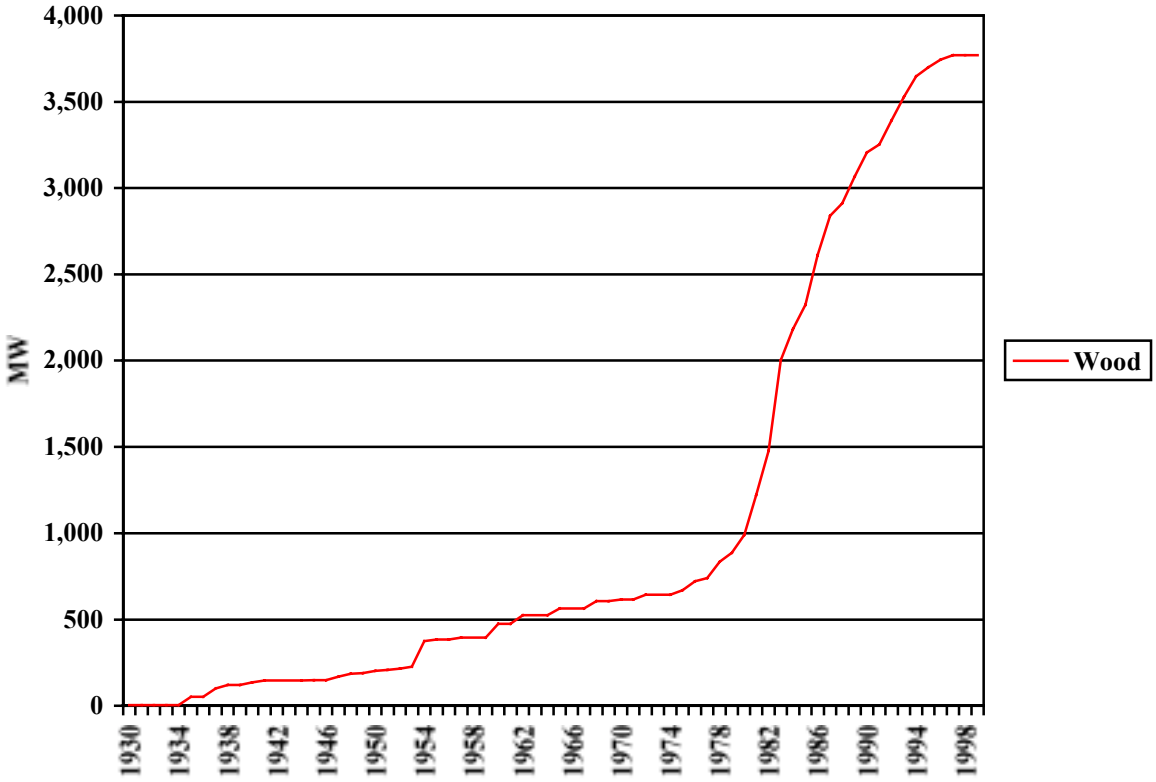
Table 8. Summary of Wood Residue Capacity in REPiS, by Current Status

Status	No. of Units	Capacity (kW)
Operational	312	6,584,828
Retired	55	477,211
Planned	4	68,800
Unknown	9	64,700
Standby	2	8,625
Total	382	7,204,164

Wood residue facilities are generally not new—the on-line date of the oldest operating wood residue facility in REPiS is 1906. Wood residues have also been co-fired with fossil fuels, by electric utilities and other companies—REPiS includes data on six utility fossil plants that co-fire a small amount of wood residues, for a total wood residue capacity in this application of 71 MW.

Wood residue capacity almost doubled in the 1980s because of tax incentives and favorable power purchase contracts. Total wood residue capacity in the United States peaked in 1997 and has largely remained flat since. Planned facilities in 2000 and 2002 will increase wood residue capacity slightly.

Figure 5. Cumulative Operating Wood Residue Capacity by Year



Note: Figure 5 does not include 2,816.5 MW of operating wood residue facilities in REPiS that do not have an identified on-line date.

As in the case of waste-to-energy, the 1990s have been a period of low market activity for wood residues, a time when several plants went out of service, either because of poor economics, or electric utilities buying out the power purchase contracts. There were 44 wood residue units that retired in the 1990s, representing almost 383 MW.

Geothermal: There are 140 geothermal units in REPiS, with a total capacity of almost 3,648 MW. Table 9 shows the current status of geothermal capacity.

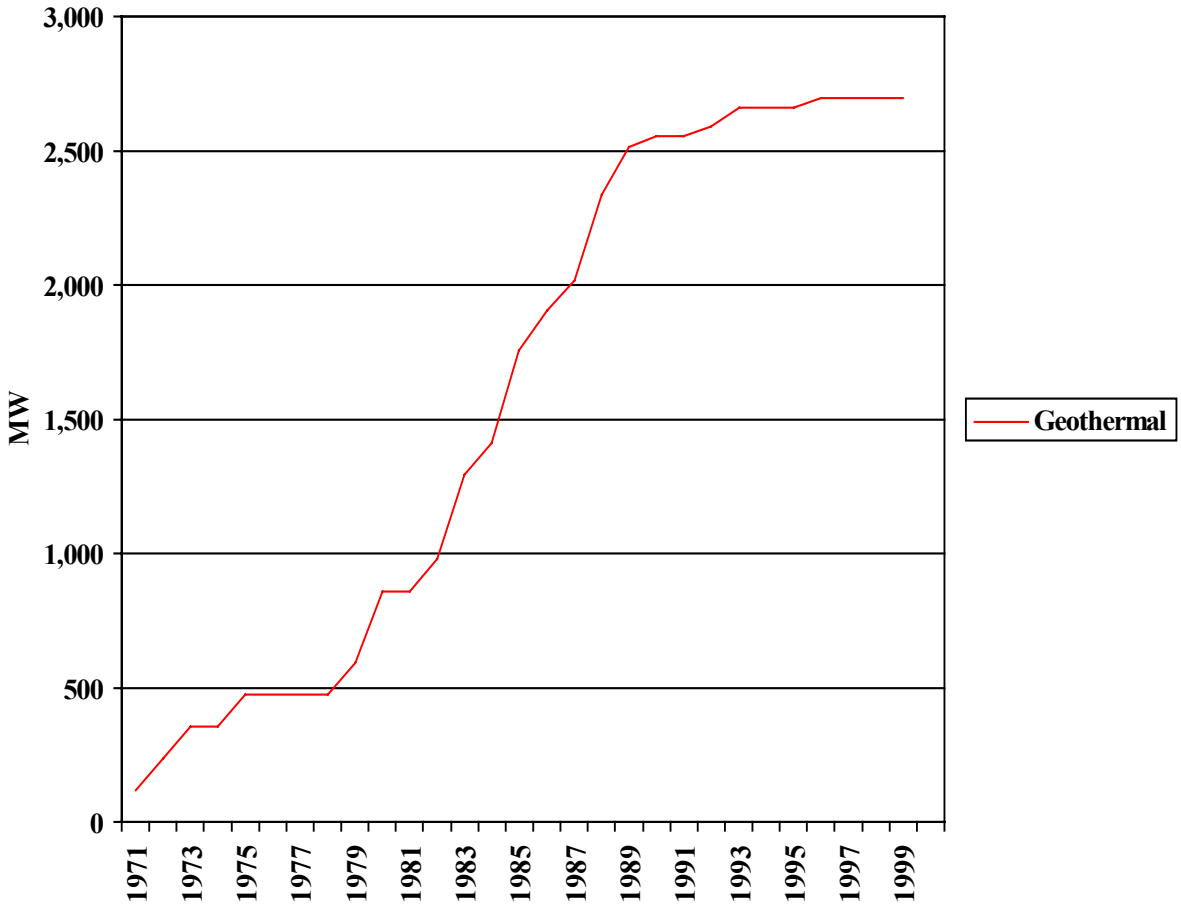
Table 9. Summary of Geothermal Capacity in REPiS, by Current Status

Status	No. of Units	Capacity (kW)
Operational	105	2,697,150
Retired	19	398,120
Planned	10	225,499
Unknown	5	272,000
Out of Service	1	55,000
Total	140	3,647,769

Operating geothermal plants tend to be divided between the larger geothermal units built at The Geysers in California, ranging from 100–120 MW, and smaller facilities under the statutory maximum of 80 MW that were developed under PURPA. Geothermal power had steady growth through the 1980s, with 52 units and 607 MW coming on-line between 1987 and 1989 alone. That steady growth did not persist into the 1990s, with only about 185 MW being developed in that decade, and no new development since 1996. About 150 MW of geothermal power is scheduled for development in California by 2002, using that state's systems benefit charge for renewable energy technologies.

The geothermal industry has also undergone some consolidation, and many geothermal companies sold their assets during the 1990s. In addition, Pacific Gas & Electric (PG&E) sold its Geysers geothermal facilities to Calpine Corporation in 1999 to comply with state restructuring legislation requiring that electric utilities sell their generating assets.

Figure 6. Cumulative Operating Geothermal Capacity by Year



Hydro: There are 5,198 hydro units in REPiS with a total capacity of more than 96,456 MW. Pumped storage hydro accounts for 19,646 MW of this total hydro capacity in REPiS. Table 10 presents the operational status of hydro capacity.

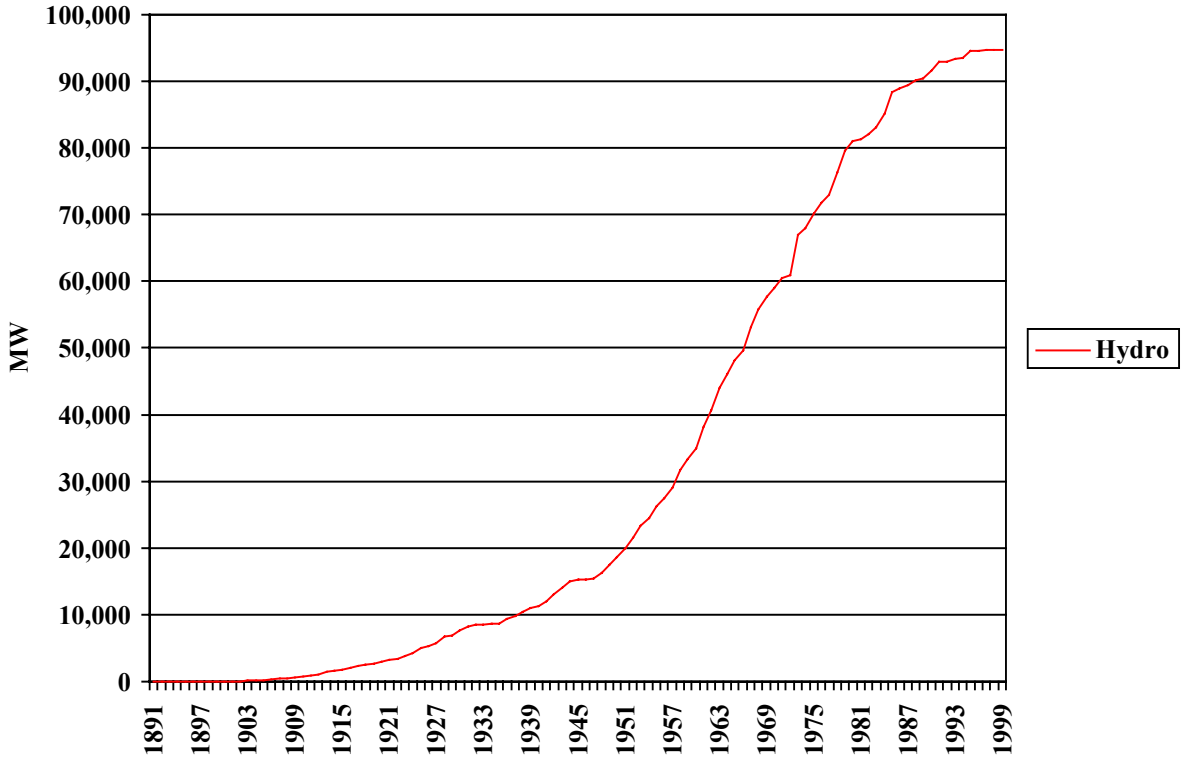
Table 10. Summary of Hydro Capacity in REPiS, by Current Status

Status	No. of Units	Capacity (kW)
Operational	4,731	94,789,367
Retired	282	414,362
Planned	41	579,910
Unknown	112	406,243
Out of Service	29	109,624
Testing	2	156,760
Standby	1	500
Total	5,198	96,456,766

The first hydro plant to produce electricity was built in 1880 in Grand Rapids, Michigan (Hydro Review 1997). Soon after the turn of the century, hydro accounted for 15% of the generating capacity in the United States, about half of which was installed at industrial facilities. Higher demand for electricity caused hydro capacity to triple between 1920 and 1940, and hydro accounted for 30% of the nation's generating capacity in the 1930s. Hydro capacity tripled again between 1940 and 1960, when government agencies such as the U.S. Army Corp of Engineers and the Bureau of Reclamation built many large dams around the country (Federal Energy Regulatory Commission [FERC] 1992).

After 1960, the construction of large hydro plants slowed because of the availability of inexpensive coal and other fossil fuels and fewer available hydro sites. The passage of PURPA in 1978 and various federal tax incentives helped stimulate the development of small hydro facilities in the 1980s. These tax incentives expired in 1988. The passage of the Electric Consumers Protection Act of 1986 gave states and private intervenors greater ability to intervene in FERC's hydro licensing process. This increased the costs of licensing for hydro developers, just as fossil fuel costs were declining, and the availability of power purchase contracts was also decreasing (Williams and Bateman 1995). As a result, hydro development slowed in the late 1980s and in the 1990s. Indeed, the 6,150 MW of hydro capacity that came on-line in the 1990s, according to REPiS data, is the lowest amount of hydro capacity to come on-line in any decade since the 1930s. Still, hydro capacity generally increases a little each year, and there is almost 580 MW of planned hydro capacity in REPiS.

Figure 7. Cumulative Operating Hydro Capacity by Year



Note: Figure 7 does not include 27 MW of operating hydro capacity in REPiS without an identified on-line date.

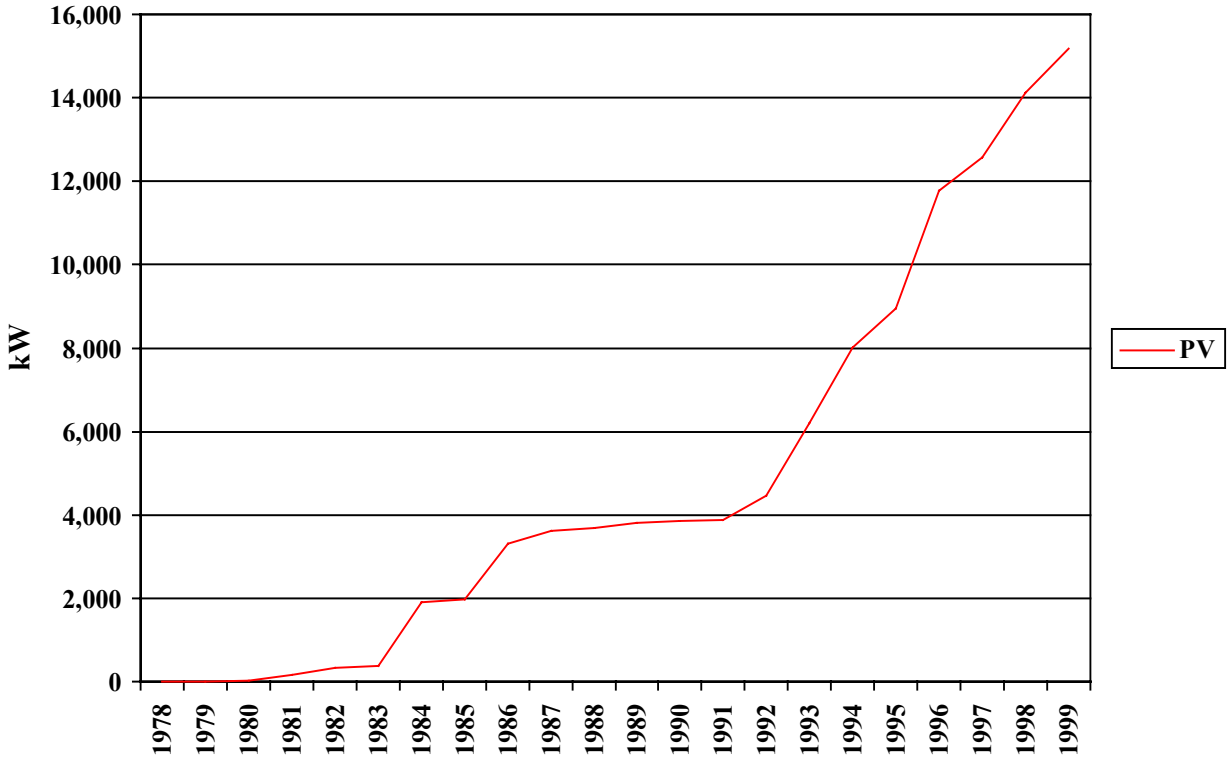
Photovoltaics: REPiS has 866 PV units for a total capacity of almost 90 MW. Table 11 gives the current status of photovoltaics capacity.

Table 11. Summary of Photovoltaics Capacity in REPiS, by Current Status

Status	No. of Units	Capacity (kW)
Operational	688	15,431.5
Retired	72	7,561.6
Planned	98	66,772.8
Unknown	5	116.5
Out of Service	3	3.3
Total	866	89,885.71

In the 1980s, PV demonstration systems of one MW and higher were installed by government, electric utilities, and private entities to test the performance and feasibility of these systems. Most of these systems are no longer in operation, either because the testing period concluded or the company involved decided to exit the PV business.

Figure 8. Cumulative Operating Photovoltaics Capacity by Year



Note: Figure 8 does not include 255 kW of operating PV capacity in REPiS that does not have an identified on-line date.

In recent years, more numerous but much smaller PV systems have been installed. Improving economics has made PV cost effective for a number of on-grid and off-grid niche applications. President Clinton also announced in 1997 an initiative to install a million solar roofs by 2010 through public-private partnerships. In addition, the Utility Photovoltaic Group has sponsored several utility PV installations through public-private partnerships with the U.S. Department of Energy (DOE). Individual utilities have also aggressively installed PV systems. One notable example is the Sacramento Municipal Utility System (SMUD), which has installed 7 MW of PV systems and plans to install 10 MW more by 2003 (Osborn 2000). As a result, there were more than 400 units of PV installed between 1993 and 1999—more than twice the number installed before 1993.

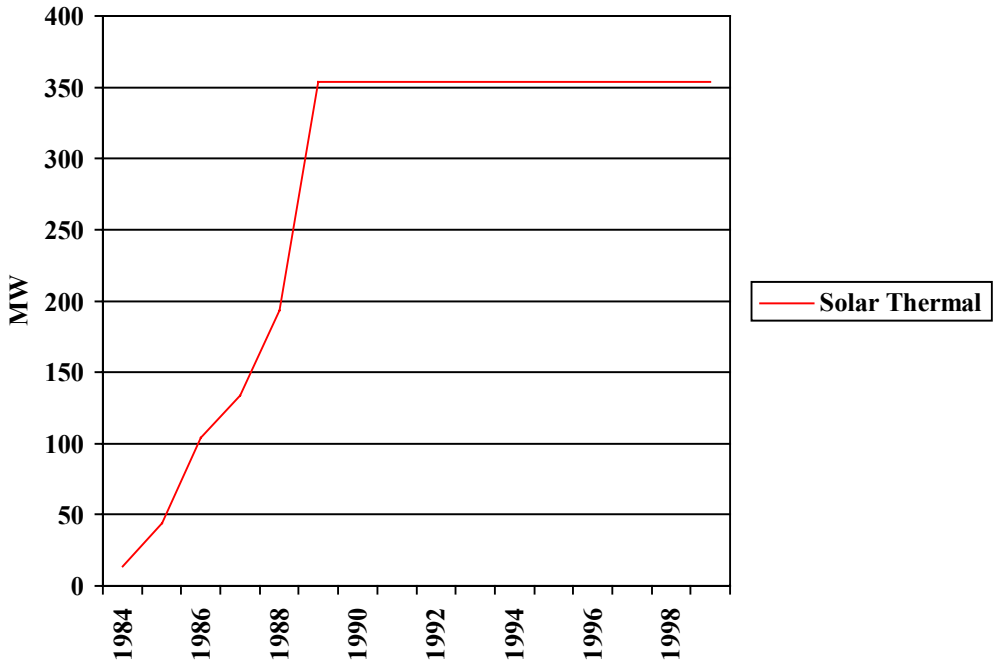
Solar Thermal: REPiS has 22 solar thermal electric units for a total of 371 MW. Table 12 provides a summary of solar thermal electric capacity.

Table 12. Summary of Solar Thermal Electric Capacity in REPiS, by Current Status

Status	No. of Units	Capacity (kW)
Operational	14	353,925
Retired	6	15,575
Planned	1	2,000
Unknown	1	7.5
Total	22	371,508

Most of the operating solar thermal electric plants, and almost all of the operating capacity, are from the parabolic trough plants developed by Luz International in the 1980s. The company developed eight such plants in southern California before the removal of various state and federal tax incentives prompted the company to cease operations in 1991. All eight of the plants Luz International developed are still in operation. Today, activity in solar thermal electric is mostly limited to research and development to reduce costs, and field tests and demonstrations. These include small parabolic-dish plants that some believe could be well positioned to take advantage of increasing interest in distributed power markets.

Figure 9. Cumulative Operating and Planned Solar Thermal Capacity by Year



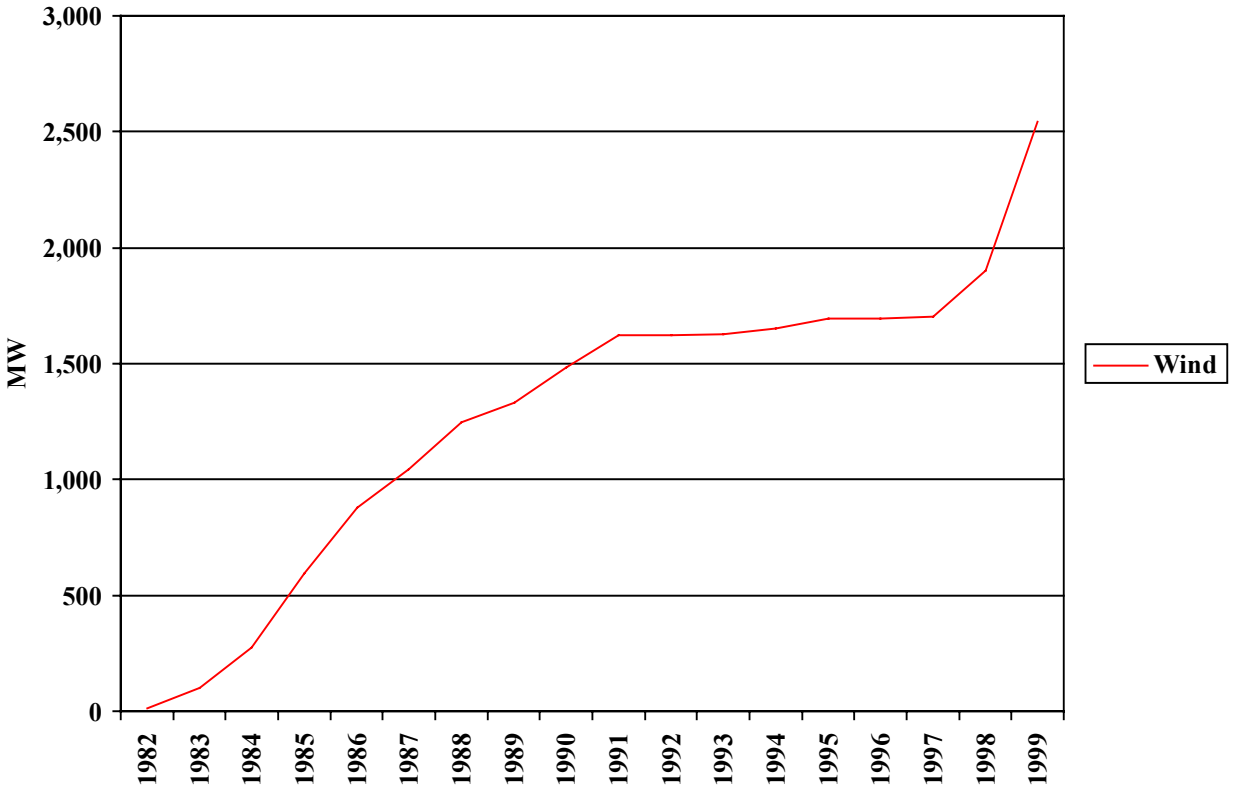
Wind: There are 1,002 wind energy units in REPiS for a total capacity of almost 4,274 MW. Table 13 represents the current status of wind energy capacity. This data includes individual wind turbine installations as well as utility-scale wind power facilities.

Table 13. Summary of Wind Energy Capacity in REPiS, by Current Status

Status	No. of Units	Capacity (MW)
Operational	546	2,602
Retired	238	302
Planned	43	1,174
Unknown	169	170
Out of Service	6	25
Total	1,002	4,273

Wind turbines have been used for years in the United States for water pumping and non-grid and grid-connected residential applications. Interest in larger wind turbines for electric power generation

Figure 10. Cumulative Operating and Planned Wind Energy Capacity by Year



Note: Figure 10 does not include 58 MW of operating wind capacity in REPiS that does not have an identified on-line date.

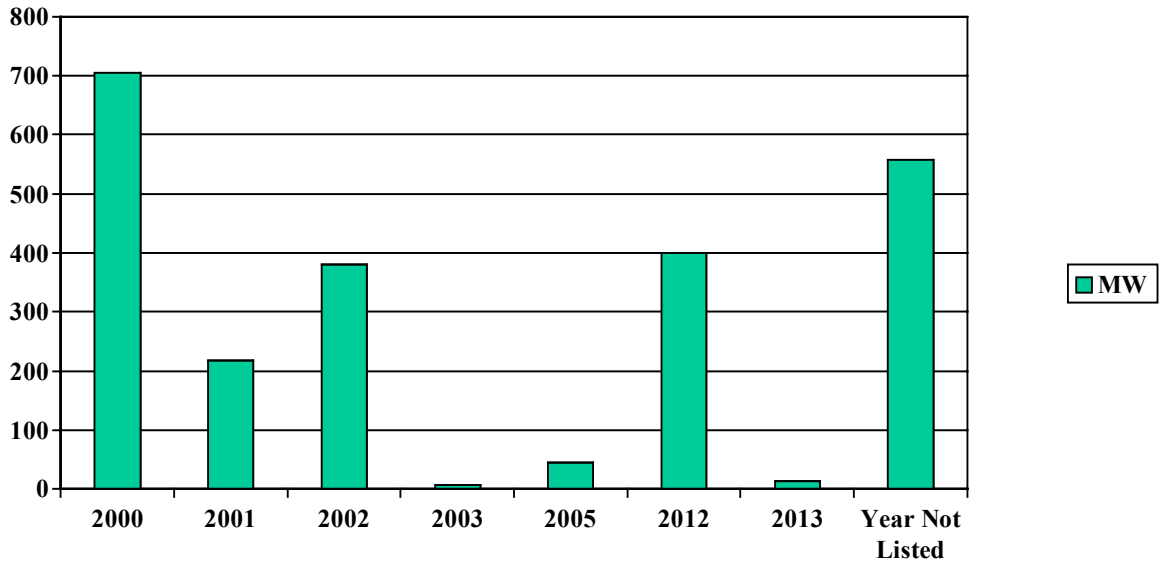
increased in the 1980s with the onset of federal and state tax incentives, and the enactment of PURPA. The data in REPiS show that installed wind capacity, starting from near zero in the early 1980s, reached 1,388 MW by 1989, with almost all of this capacity located in California. The

expiration of tax incentives in 1985 and lower fossil fuel prices resulted in a relatively stagnant market for wind in the early-to-mid 1990s. A production tax credit (PTC) included in the Energy Policy Act of 1992 (EPAct), and continuing cost declines and performance improvements sparked some new interest in wind, with installed capacity reaching 1,960 MW by 1998. A combination of improved market conditions, state policy mandates, and the scheduled expiration of the PTC (since extended through 2001) resulted in almost 700 MW of new wind capacity added in 1999, according to data in REPiS. Wind development has also moved beyond California to encompass over 20 states, and more than 1,100 MW of wind is in various stages of planning.

Planned Renewable Energy Units

To the extent available, data were collected on planned units for REPiS, defined in REPiS as renewable energy units that would begin operating in 2000 or later. Data sources for planned units are incomplete, and the data in REPiS probably does not capture the universe of planned grid-connected renewable energy units. Therefore, the planned data in REPiS should be viewed as illustrative, not comprehensive. There are about 250 planned units representing about 2,300 MW of capacity by 2013. Figure 11 shows this data graphically. These numbers are down from the 1994 edition of REPiS, which included 257 planned units and a total capacity of almost 8,000 MW.

Figure 11. Planned Renewable Electric Capacity by Year Expected On-Line (MW)



All of the renewable electric technologies had less planned capacity than in the 1994 edition of REPiS, sometimes sharply so (see Table 14). Some of the decline is partly due to tighter market conditions and uncertainty over electric restructuring; however, it may also be due to developers keeping project development plans confidential as the generation market becomes more competitive. In addition, renewable energy policies such as the renewables portfolio standard (RPS) and the systems benefit charge (SBC) will create some new renewable electric power plants (Wiser, Porter,

and Clemmer 2000). These policies are only partially reflected in REPiS because, for the most part, these policies are not fully implemented yet. REPiS does capture some state renewable policies if they are technology specific. An example is the Minnesota Public Utility Commission's 1998 order to Northern States Power to competitively bid for an additional 400 MW of wind by 2012.

A probability-of-success variable was not assigned to planned units. Unlike the previous edition of REPiS, this edition of REPiS treats all planned units as equally likely to be developed. For this reason, some caution should be used in interpreting aggregate data on planned renewable electric units, as unexpected developments may prevent these planned units from coming on-line. This is even more true as the electric power market evolves into a more "merchant-style" environment, in which plant developers build an electric facility with customers for only some, or even none, of the plant's output. For instance, American National Power brought a 30-MW wind plant on-line in Texas in 1999, and announced plans to develop 250 MW more if warranted by market conditions. That planned facility is listed in REPiS, even though there is no projected on-line date, and future market conditions may not allow the company to go forward with the plant. Conversely, some planned hydro facilities have been in planning for several years, in part because of the difficulties in siting and receiving state and federal permits.

Wind leads all the renewable electric technologies with 1,174 MW of planned capacity, followed by biomass with 272 MW and geothermal with 225 MW. Improved economics, the production tax credit, and some favorable state policies explain why wind is doing better than the other renewable energy technologies. Photovoltaics has a sharp increase in the number of units in this edition of REPiS, from 11 to 98, although the small size of each unit keeps the overall planned capacity at 66.7 MW.

Table 14. Planned Renewable Units and Capacity by Technology by REPiS Edition

Technology	No. of Units	Capacity (kW)	No. of Units 1994 Edition	Capacity (kW) 1994 Edition
Biomass	58	272,496	86	1,142,650
Geothermal	10	225,499	21	710,000
Hydro	41	579,910	87	4,147,412
Photovoltaics	98	66,733	11	105,500
Solar Thermal	1	2,000	3	10,015
Wind	43	1,174,060	49	1,842,305
Total	251	2,320,698	257	7,957,882

Leading States in Renewable Energy Capacity Development

Table 15 presents the leading states in the amount of operating renewable energy capacity. Washington has the most renewable energy capacity, all but 305 MW from hydro. California is next, followed by Oregon, New York, Tennessee, Georgia, South Carolina, Alabama, Virginia, and Arizona.

Table 15. States with the Most Operating Renewable Energy Capacity in REPiS

State	Renewable Energy Capacity (kW)
Washington	20,988,683
California	18,687,494
Oregon	8,502,366
New York	6,006,570
Tennessee	3,965,238
Georgia	3,769,458
South Carolina	3,741,574
Alabama	3,603,450
Virginia	3,507,662
Arizona	2,993,958

Table 16 lists the states with the most operating non-hydro renewable electric capacity. Excluding hydro markedly changes the state capacity rankings, as compared to Table 15. Of the 10 states in Table 15, only Alabama, California, Georgia, and New York also rank high with non-hydro renewable energy capacity.

Table 16. States with the Most Operating Non-Hydro Renewable Energy Capacity in REPiS

State	Renewable Energy Capacity (kW)
California	5,498,537
Florida	1,024,607
Maine	756,405
Alabama	743,780
Minnesota	530,122
Louisiana	524,600
Michigan	483,845
New York	471,361
Georgia	458,979
Texas	433,627

Planned renewable units are found in 41 states, representing a total of 2,320 MW. This compares to 36 states in the 1994 edition of REPiS; however, that edition of REPiS showed more planned capacity, at 7,957 MW. Table 17 below lists the five states with the most planned renewable energy capacity. See Table A-2 in the Appendix for a list of states with planned renewable energy capacity.

Table 17. States with the Most Planned Renewable Energy Capacity

State	Capacity (kW)
California	587,479
Minnesota	490,002
Nevada	259,999
Texas	231,013
Alaska	144,960

Comparison to the 1994 Edition of REPiS

There was a 7% increase in operating renewable electric capacity in REPiS between 1994 and 1999 (see Table 18 below). Although some of this was due to more renewables capacity coming on-line, some of it is due to improved data sources in this version of REPiS.

Biomass experienced the greatest growth of any technology in REPiS, an increase of as much as 85% from the previous edition of REPiS, or 17% annually. This is primarily because better data sources were available that captured more of the operating biomass power plants than previous data sources. Specifically, the California Biomass Energy Alliance published a directory of biomass facilities in 1998 that included several wood residue plants that were not included in REPiS (Reese 1998). Concerning other renewable energy technologies, photovoltaics had growth of 75% (15% annually), which is likely due to the success of several public-private partnerships. Geothermal and solar thermal had slight decreases in capacity because of a change in defining installed capacity in REPiS from gross capacity to net capacity.

Table 18. Comparison in Capacity (kW) Between REPiS III and REPiS IV, by Technology

	Biomass	Geothermal	Hydro*	PV	Solar Thermal	Wind	Total
REPiS III	5,739,215	2,904,858	92,671,697	8,778	367,748	2,154,354	103,846,650
REPiS IV	10,658,887	2,697,150	94,789,367	15,432	353,925	2,601,695	111,116,455
Net	4,919,672	-207,708	2,117,670	6,654	-13,823	447,341	7,269,805
% Change	85.72	-7.15	2.29	75.80	-3.76	20.76	7.00

* Includes pumped storage hydro.

Table 19 presents a comparison between the data in REPiS, and utility and non-utility renewable electric technology data collected by EIA (EIAa 1999). Overall, there is slightly less renewables capacity in REPiS than in EIA's data, but there are substantial differences by renewable energy technology. For example, REPiS has about three times as much photovoltaics capacity as EIA does—EIA does not collect data on facilities under one MW, whereas REPiS has no such distinction. REPiS also has more data on wind capacity, but that may be a function of publication rather than data completeness. EIA's most recent report does not capture the 700 MW of wind that became operational in 1999 to take advantage of the then-expiring production tax credit. REPiS has less renewables electric capacity than EIA in geothermal, hydro, and solar thermal.

Table 19. Comparison in Capacity (kW) Between EIA and REPiS, by Technology

	Biomass	Geothermal	Hydro*	PV	Solar Thermal	Wind	Total
EIA (1998)**	10,374,000	2,999,000	98,559,000	5,000	385,000	1,689,000	114,011,000
REPiS IV	10,658,887	2,697,150	94,789,367	15,432	353,925	2,601,695	111,116,455
Net	284,887	-301,850	-3,769,633	10,432	-31,075	912,695	-2,894,545
% Difference	2.75	-10.07	-3.82	208.64	-8.07	54.04	-2.54

* Includes pumped storage hydro.

** Source: Energy Information Administration. *Electric Power Annual 1998*, Vol. II, DOE-EIA-0348(2), Table 1, pp. 12-13.

Implications for REPiS from Electric Restructuring

Electric restructuring was just emerging when the 1994 edition of REPiS was released in 1995. At the time, only California and Rhode Island had started to restructure their electric power sector, and no electric utility had sold off its generating facilities, either voluntarily or under state order. Since then, more than 20 states have passed electric restructuring legislation or regulatory orders, and several utilities have divested their generation facilities to non-utility parties. Almost all of the renewable electric facilities divested by electric utilities have been hydro facilities—the notable exceptions include PG&E's geothermal facilities at The Geysers, and a geothermal plant owned by SMUD.

Electric restructuring will change the way data on electric power are collected. Data availability will be more restricted, especially commercially sensitive data such as capital cost and plant operation and maintenance costs. Several electric utilities have objected that the data they file with the Federal Energy Regulatory Commission (FERC) contains sensitive information, and have petitioned the agency to keep the forms confidential. FERC has denied these petitions, but promised to consider the issue further in 2000 (FERC 1999). EIA announced that, as of 1999, they will no longer collect data on plant retirement dates, planned generating capacity, projected fuel consumption, changes to existing generating units, fuel inventory stocks, plant heat rates, and sales to other end users (EIAc 1999). However, EIA is publishing monthly generation data from non-utility power plants, data it previously kept confidential (EIAb 1999).

Besides data availability, changes in electric power industry structure may also affect REPiS. In essence, REPiS is designed to capture utility-owned renewable electric facilities, or non-utility renewable electric facilities that sell power to a single utility, such as a power sales contract under PURPA. In a restructured market, different types of entities will own, buy, or market generation. Renewable electric facilities in a post-restructured electric power market could sell output to a power exchange, individual customers, customer aggregators, to several utilities, or to any combination of the above. Finally, renewables may be developed in different market niches, such as for green power markets, or for distributed power applications, which REPiS is not currently designed to capture. These possible changes in industry and market structure may require REPiS to be redesigned in the future.

Summary

REPiS is a database of grid-connected renewable electric facilities. The purpose of the database is to catalog all known renewable electric facilities in the United States, and make the data publicly available. REPiS is a useful tool for researchers who want more detailed information on individual projects, renewable energy companies, or small renewable energy projects not cataloged elsewhere. Users can also sort or manipulate data on renewable electric plants for their own individual needs.

This edition of REPiS includes data on 137 GW of renewable electric plants, with 111 GW of operating renewable electric plants; 3 GW of planned renewable electric plants; and another 23 GW of renewable electric plants that are either retired, on standby, out of service, for which the operating status is unknown. Hydro accounts for over 112 of the 137 GW in REPiS, and biomass amounts to more than two-thirds of the non-hydro capacity in REPiS.

REPiS has slightly less capacity data than what is published by EIA, although there are significant differences by renewable energy technology. EIA does not collect data on facilities of less than 1 MW in capacity, whereas REPiS has no capacity restriction. This probably explains why REPiS has more photovoltaics capacity than EIA. However, REPiS has less geothermal, hydro, and solar thermal capacity than EIA.

Finally, electric restructuring will change how data on electric power is collected, and this may change future editions of REPiS. As electric markets become competitive, electric companies and suppliers will become more reluctant to reveal data that they consider sensitive. EIA recently announced they will withhold some data they previously published, and FERC plans to examine this issue more closely in the near future.

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APPENDIX A

Table A-1. Operating Renewable Electric Capacity by State (kW)

State	Biomass	Geothermal	Photovoltaics	Solar Thermal	Wind	Non-Hydro Total Capacity	Hydro	Total Capacity with Hydro
Alabama	743,780					743,780	2,859,670	3,603,450
Alaska	5,000		10		975	5,985	392,859	398,844
Arizona	350		1,089	75	38	1,552	2,992,406	2,993,958
Arkansas	280,700		20			280,720	1,196,720	1,477,440
California	1,013,534	2,464,800	9,402	353,800	1,657,001	5,498,537	13,188,957	18,687,494
Colorado	9,605		246		21,600	31,451	1,164,407	1,195,858
Connecticut	281,020		9		55,980	337,009	158,085	495,094
D.C.			313			313		313
Delaware	600		18		2	619	500	1,119
Florida	1,024,350		257			1,024,607	45,310	1,069,917
Georgia	458,597		357		25	458,979	3,310,479	3,769,458
Hawaii	156,600	25,000	272		11,200	193,072	22,777	215,849
Idaho	98,080		18			98,098	2,518,306	2,616,404
Illinois	114,106		26			114,132	40,498	154,630
Indiana	10,600		4			10,604	91,420	102,024
Iowa	17,983		6		257,992	275,981	133,585	409,566
Kansas					2,879	2,879	2,728	5,607
Kentucky	4,600		54			4,654	753,367	758,021
Louisiana	524,600					524,600	192,000	716,600
Maine	756,250		13		142	756,405	699,681	1,456,086
Maryland	137,700		61		4	137,765	494,550	632,315
Massachusetts	244,380		303		360	245,043	1,733,235	1,978,278
Michigan	483,111		77		657	483,845	2,412,127	2,895,972
Minnesota	255,120		72		274,931	530,122	212,984	743,106
Missouri	1,300		4			1,304	1,045,000	1,046,304
Mississippi	169,821					169,821		169,821
Montana	12,150				130	12,280	2,452,454	2,464,734
North Carolina	360,350		44			360,394	1,951,779	2,312,173
North Dakota	9,000				849	9,849	517,750	527,599
Nebraska					3,660	3,660	183,930	187,590
New Hampshire	158,163		40		89	158,292	366,206	524,498
New Jersey	257,300		71			257,371	404,263	661,634
New Mexico			76		660	736	80,020	80,756
New York	470,278		1,053		30	471,361	5,535,209	6,006,570
Nevada		168,050	111		10	168,171	1,050,735	1,218,906
Ohio	81,750		2			81,752	129,000	210,752
Oklahoma	35,000		22		200	35,222	1,044,285	1,079,507
Oregon	271,860		11		24,943	296,814	8,205,552	8,502,366
Pennsylvania	336,980		140		50	337,170	1,944,053	2,281,223
Rhode Island	12,000		19		10	12,029	6,857	18,886
South Carolina	288,000					288,000	3,453,574	3,741,574
South Dakota					10	10	1,741,058	1,741,068

Table A-1. Operating Renewable Electric Capacity by State (kW) *(continued)*

State	Biomass	Geothermal	Photovoltaics	Solar Thermal	Wind	Non-Hydro Total Capacity	Hydro	Total Capacity With Hydro
Tennessee	147,785		33			147,818	3,817,420	3,965,238
Texas	242,860		956		189,811	433,627	631,190	1,064,817
Utah	7,700	39,300			18	47,018	287,695	334,713
Virginia	419,800		71			419,871	3,087,791	3,507,662
Vermont	76,330		12		6,050	82,392	459,390	541,782
Washington	305,500		7	50		305,557	20,683,126	20,988,683
Wisconsin	284,995		88		21,580	306,663	511,272	817,935
West Virginia						0	285,790	285,790
Wyoming			46		69,810	69,856	297,317	367,173
Total	10,658,887	2,697,150	15,432	353,925	2,601,695	16,237,788	94,789,367	111,027,155

Table A-2. Planned Capacity by Technology and State (kW)

State	Biomass	Geothermal	Photovoltaics	Solar Thermal	Wind	Total Non-Hydro	Hydro	Total Including Hydro
Alaska						0	144,960	144,960
Alabama	4,000					4,000		4,000
Arkansas			10			10		10
Arizona	2,425		377			2,802		2,802
California	67,305	104,000	10,794		292,380	474,479	113,000	587,479
Colorado			152			152		152
Connecticut	2,000		1			2,001		2,001
Delaware	1,500					1,500		1,500
Florida	3,800		299			4,099		4,099
Georgia	3,000		15			3,015		3,015
Hawaii			85			85		85
Iowa	3,000				600	3,600		3,600
Idaho			6			6		6
Illinois	65,366		250			65,616		65,616
Indiana	4,000					4,000		4,000
Kansas	3,000					3,000		3,000
Kentucky						0	105,000	105,000
Louisiana	3,000		40			3,040		3,040
Massachusetts	6,700		74		7,500	14,274		14,274
Maryland			60			60		60
Maine					26,000	26,000	42,700	68,700
Michigan			50			50		50
Minnesota	65,000		2		425,000	490,002		490,002
Missouri						0	50,000	50,000
North Carolina			3			3		3
Nebraska					660	660		660
New Hampshire			4			4		4
New Mexico			3,000	2,000		5,000		5,000
Nevada		91,499	50,000		118,500	259,999		259,999
New York			45		19,000	19,045	7,200	26,245
Ohio	5,000		22			5,022		5,022
Pennsylvania	1,000		86		10,000	11,086		11,086
Rhode Island			3		2,000	2,003		2,003
Texas	6,400		113		224,500	231,013		231,013
Utah		30,000				30,000	4,250	34,250
Virginia			270			270		270
Vermont			7		4,620	4,627		4,627
Washington	26,000					26,000	32,800	58,800
Wisconsin			1,006		30,000	31,006		31,006
West Virginia						0	80,000	80,000
Wyoming					13,300	13,300		13,300
U.S. Total	272,496	225,499	66,773	2,000	1,174,060	1,740,828	579,910	2,320,698

Table A-3. Summary of Cancelled Capacity in REPiS, by Renewable Fuel Source

Renewable Fuel Source	No. of Units	Capacity (kW)
Agricultural Waste	2	32,500
Biogas	16	32,806
Energy Crops	1	75,000
Waste-to-Energy	49	1,142,900
Wood Residues	10	176,400
Total Biomass	78	1,459,606
Geothermal	32	1,459,100
Hydro	191	16,293,317
Photovoltaics	4	108,470
Solar Thermal	7	331,214
Wind	48	716,195
Total	360	20,367,902

Table A-4. States with the Most Operating Agricultural Waste Capacity in REPiS

State	Capacity (kW)
California	176,550
Hawaii	107,600
Florida	25,000
Tennessee	20,000
Louisiana	13,000

Table A-5. States with the Most Operating Geothermal Capacity in REPiS

State	Capacity (kW)
California	2,464,800
Nevada	168,050
Utah	39,300
Hawaii	25,000

Table A-6. States with the Most Operating Hydro Capacity in REPiS

State	Capacity (kW)
Washington	20,683,126
California	13,188,957
Oregon	8,205,552
New York	5,535,209
Tennessee	3,817,420
South Carolina	3,453,574
Georgia	3,310,479
Virginia	3,087,791
Arizona	2,992,406
Alabama	2,859,670

Table A-7. States with the Most Operating Biogas Capacity in REPiS

State	Capacity (kW)
California	344,089
Illinois	113,406
Michigan	77,491
Pennsylvania	51,300
New Jersey	40,800

Table A-8. States with the Most Operating Municipal Solid Waste Capacity in REPiS

State	Capacity (kW)
Florida	425,150
Connecticut	273,000
New York	264,200
Pennsylvania	219,000
New Jersey	216,500

Table A-9. States with the Most Operating Photovoltaics Capacity in REPiS

State	Capacity (kW)
California	9,402
Arizona	1,089
New York	1,053
Texas	956
Georgia	357

Table A-10. States with the Most Operating Wind Capacity in REPiS

State	Capacity (kW)
California	1,657,001
Minnesota	274,931
Iowa	257,992
Texas	189,811
Wyoming	69,810

Table A-11. States with the Most Operating Wood Residue Capacity in REPiS

State	Capacity (kW)
Alabama	738,780
Florida	547,900
Maine	541,250
Louisiana	511,600
Georgia	456,196

Appendix B

Primary Data Fields

Primary Data Fields

Table B-1. Primary Data Fields

Plant Name(s)
Unit Name
Unit Owner(s)
Plant Location (where available)
Installed Nameplate Capacity
Year of Installation
Technology, System Type, and Fuel Type
Purchasing Utility

Appendix C

Plant Name, Location, and Utility Table

Table C-1. Plant Name, Location, and Utility Table Structure

Field Name	Field Type	Size (in characters)
ID Code	Text	255
Plant Name	Text	255
Utility Name	Text	255
Relationship (Code)	Text	255
Landmark	Text	255
City	Text	255
County	Text	255
State (Code)	Text	2
Zip	Numeric	
# of Units	Numeric	

Table C-2. Relationship between Plant and Utility

Relationship Codes	Code Description
C	Plant is Contracted to Sell Power to Utility
IC	Interconnected with Utility
NA	Information is Not Available
OP	Utility Owns the Plant

Table C-3. State Code and FERC Region

State	State Name	FERC Region
AK	Alaska	10
AL	Alabama	4
AR	Arkansas	6
AZ	Arizona	9
CA	California	9
CO	Colorado	8
CT	Connecticut	1
DC	District of Columbia	3
DE	Delaware	3
FL	Florida	4
GA	Georgia	4
HI	Hawaii	9
IA	Iowa	7
ID	Idaho	10
IL	Illinois	5
IN	Indiana	5

Table C-3. State Code and FERC Region

State	State Name	FERC Region
KS	Kansas	7
KY	Kentucky	4
LA	Louisiana	6
MA	Massachusetts	1
MD	Maryland	3
ME	Maine	1
MI	Michigan	5
MN	Minnesota	5
MO	Missouri	7
MS	Mississippi	4
MT	Montana	8
NC	North Carolina	4
ND	North Dakota	8
NE	Nebraska	7
NH	New Hampshire	1
NJ	New Jersey	2
NM	New Mexico	6
NV	Nevada	9
NY	New York	2
OH	Ohio	5
OK	Oklahoma	6
OR	Oregon	10
PA	Pennsylvania	3
RI	Rhode Island	1
SC	South Carolina	4
SD	South Dakota	8
TN	Tennessee	4
TX	Texas	6
UT	Utah	8
VA	Virginia	3
VT	Vermont	1
WA	Washington	10
WI	Wisconsin	5
WV	West Virginia	3
WY	Wyoming	8

Appendix D

Unit and Owner Table

Table D-1. Unit and Owner Table Structure

Field Name	Type	Size (in characters)
ID Code	Text	10
Unit Code	Text	10
Fuel Code	Text	10
Owner Name	Text	255
Status Code	Text	10
Status Yr	Numeric	
Tech Code	Text	10
Sys Type Code	Text	10
Owner Code	Text	255
% of Unit Owned	Numeric	
Notes	Text	255

Table D-2. Status Codes

Status Code	Description	Classification
CN	Cancelled	Retired
OP	Operating	Operating
PL	Planned (Unit Not Under Construction)	Planned
RE	Retired	Retired
SB	Standby	Operating
TS	Testing	Operating
UNK	Unknown	Unknown

Table D-3. Technology Codes

Tech Code	Description
BIO	Bioenergy
G	Geothermal
H	Hydro
P	Photovoltaic
ST	Solar Thermal
W	Wind

Table D-4. System Type Codes

System Type Code	Description
(Blank)	Unknown System Type
AB	Atmospheric Fluidized-Bed Clean-Burning Plant (BIO)
B	Binary (GEO)
C	Concentrating (PV)
CC	Combined Cycle (BIO)
CR	Central Receiver (ST)
CS	Central Station (PV)
D	Distributed (PV)
DF	Dual Flash (GEO)
DS	Dry Steam (GEO)
DSTR	Dish Stirling (ST)
FP	Flat Plate (PV)
GT	Gas Turbine (BIO)
GE	Geothermal - Unknown System Type
GP	GeoPressure (GEO)
HTC	Hydraulic Turbine Conventional
HTP	Hydraulic Turbine Pipeline
HTR-PS	Hydraulic Turbine Reversible-Pumped Storage
HY	Hydro - Unknown System Type (HTC or HTP)
IC	Internal Combustion (BIO)
MT	Multiple Turbines (Wind Farm)
PD	Parabolic Dish (ST)
PS	Pumped Storage (H)
PT	Parabolic Trough (ST)
SF	Single Flash (GEO)
SP	Photovoltaic - Unknown System Type (CS or D)
SST	Solar Steam Turbine - Unknown System Type (CR or PD or PT)
ST<100	Single Turbine <100 kW
ST>100	Single Turbine >100 kW
STT	Steam Turbine (BIO)
TF	Triple Flash (GEO)
WT	Wind Turbine - Unknown System Type (MT or ST)

Units using bioenergy (biomass) technology will have system types that depend on the fuel type used. Possible system types for bioenergy are:

AB - Atmospheric fluidized-bed clean-burning plant (all fuel types)
IC - Internal combustion (biogas fuel type)
STT- Steam turbine (all fuel types)

Table D-5. Fuel Codes

Fuel Code	Description	Classification
AR	Agricultural Residues (Waste)	Bioenergy
BG	Biogas	Bioenergy
ER	Energy Crops	Bioenergy
GST	Geothermal Steam	Geothermal
MSW	Municipal Solid Waste (Including Industrial and Medical)	Bioenergy
SUN	Solar	Sun
TR	Timber Residues (Milling and Logging Residues)	Bioenergy
UNK	Unknown	Unknown
WAT	Water	Water
WND	Wind	Wind

Table D-6. Bioenergy (Biomass) Fuel Code Descriptions

Bioenergy Fuel Code	Description
AR	Agricultural Residues (Waste)
	Cannery Wastes
	Nut Hulls
	Fruit Pits
	Nut Shells
BG	Biogas
	Alcohol (Term Includes Butanol, Ethanol, and Methanol)
	Bagasse
	Hydrogen
	Landfill Gas (Refuse Gas) see also METHANE
	Livestock Manure
	Methane (LGAS or Sewage Gas) Includes Digester Gas
	Refuse Gas
	Municipal Sewage
	Wood Gas (from Wood Gasifier)
ER	Energy Crops
	Grains (Corn, Rice, Wheat)
MSW	Municipal Solid Waste (Including Industrial and Medical)
	Hazardous Waste
	Refuse-Derived Fuel (Combustible Portion of Refuse)
	Refuse (Garbage, Trash) (Brush, Dirt, Food Waste, Grass, Greens, Leather, Leaves, Oils, Paints, Paper, Plastics, Rags, Rubber, Wood)
	Scrap Tires (Could be Shredded)
	Wastewater Sludge

Table D-6. Bioenergy (Biomass) Fuel Code Descriptions

Bioenergy Fuel Code	Description
TR	Timber Residues (Milling Residues and Logging Residues)
	Tree Bark
	Wood Chips (from Milling/Logging)
	Hog (Hogged) Fuel
	Pulping Liquor
	Paper Mill Sludge
	Peat
	Tree Pitch
	Sander Dust (from Milling)
	Sawdust (from Milling)
	Shavings (from Milling)
	Tree Trim (from Milling)
	Wood or Wood Waste

Table D-7. Owner Codes

Owner Code	Description	Classification
A	Public Authorities (State, Cities, Counties, etc.)	Publicly Owned
C	Cooperatives	Cooperatives
F	Federally Owned	Publicly Owned
M	Municipal	Publicly Owned
N	Nonutilities	Nonutilities
P	Investor-Owned Utilities	Investor Owned

Appendix E

Database Design and Methodology

Database Design

REPiS includes information on all the renewable energy technologies, including biomass, geothermal, hydroelectric, photovoltaic (PV), solar thermal, and wind. To the extent available, data is divided into the unit level, rather than plant level. Data collected for each renewable energy unit, again depending on availability, includes owner name, plant name, technology type, system type, number of units, fuel type, unit capacity, location, on-line date, operating status, and the purchasing utility of power from a non-utility plant. REPiS consists of six tables, the two most important of which are unit owner and plant location. See Appendices B through D for more details.

Data on the renewable electric units in REPiS is current through mid-1999, except for wood and hydro, for which the data is current through 1998, and in some specific cases, through mid-1999. Information on planned units goes from 2000 to 2013, although some planned units do not have an identified on-line date, either because one has not been announced or because information is unavailable.

Unlike previous editions, this edition of REPiS does not include generation data or revenue and cost data, because of the difficulties of acquiring such data, and because of funding constraints. Data on non-utility projects is filed with the Energy Information Administration (EIA), but plant-level data is kept confidential. Some electric utilities report purchases from and expenditures paid to non-utility generators; however, this data is not in a standard format, and some utilities do not report it at all. For these reasons, this edition of REPiS was streamlined to focus more on plant ownership, capacity, and operating status.

Methodology

The data in REPiS comes from publicly available sources, such as federal and state government publications and reports; trade association data sources; trade press literature such as weekly newsletters; and personal communications with industry and government officials. No surveys were conducted to collect data. Information in the database was collected through a massive literature search.

To begin with, the National Renewable Energy Laboratory (NREL) sent a letter in August 1998 to all 50 state public utility commission offices, with printouts from REPiS of renewable electric installations in each state. We received helpful publications and comments from about half of the states. The state data, along with various project-specific trade press articles and personal communications with industry and government officials, were important data sources for all of the renewable electric technologies. In some cases, NREL used company annual report filings to

the Securities and Exchange Commission (SEC), if a renewable energy company had stock that is publicly traded.

More specific sources of data and methodology is discussed below by technology:

Biomass: REPiS includes data on wood and agricultural waste, as well as waste-to-energy (WTE) and biogas facilities. The primary reference for wood and agricultural waste was an inventory of these facilities prepared by the California Biomass Energy Alliance in 1998 (Reese 1998). The data in this report consisted mostly of plant location, plant capacity, and how much of the plant capacity was consumed at the plant site or delivered to the electric grid. Data in this report was compared to EIA's inventory of non-utility facilities (EIAa 1999).

Co-firing of wood and/or refuse with fossil fuel, primarily coal, is also represented in REPiS. Only facilities that regularly co-fire biomass with fossil fuels were included in REPiS—facilities that co-fired biomass with fossil fuels on a testing or experimental basis were not included. Data sources included EIA (EIAa 1999), and a list of biomass co-firing at fossil electric plants provided by the Antares Corporation (Comer 1999).

Two directories by Governmental Advisory Associates provided the bulk of information used to update the municipal solid waste and landfill methane facilities in REPiS. About 80% of the waste-to-energy and 70% of the landfill methane facilities in each report are grid connected, and these were added to REPiS (Berenyi 1997; Berenyi 1999a). NREL also received some updates by Dr. Eileen Berenyi, the author of the two reports (Berenyi 1999b).

Geothermal: The U.S. Department of Energy's (DOE's) Geothermal Office and the Interagency Geothermal Coordinating Council (IGCC) published an annual update of geothermal activities through 1997. The report included a list of geothermal electric plants in the United States (Interagency Geothermal Coordinating Council 1997). Here, trade press articles and company filings to the SEC were critical, as a number of existing geothermal facilities have changed owners since REPiS was last updated. For example, Pacific Gas and Electric (PG&E) sold its geothermal plants at The Geysers to Calpine Corporation, and the California Energy Company sold a 50% interest in its geothermal facilities as part of the company's acquisition of MidAmerican Energy Co., an investor-owned utility in Iowa (MidAmerican 1998 10-K). The California Energy Commission's (CEC's) list of winning bidders in the 1998 new renewable resources auction was also used to identify planned geothermal facilities in California (California Energy Commission 1998). REPiS does not include non-grid geothermal facilities, such as geothermal heat pumps.

Hydro: REPiS includes conventional, run-of-the-river, and pumped storage hydro projects. The Federal Energy Regulatory Commission (FERC) provided a list of operating hydro projects (FERC 1999a; FERC 1999b). We also used EIA publications (EIAa 1999).

Solar: The Utility Photovoltaic Group (UPVG), a trade association of electric utilities involved in photovoltaics R&D and deployment, provided a database of U.S. PV installations that is current through April 1998 (UPVG 1998). DOE's Photovoltaics Program provided an

electronic spreadsheet of known PV installations in the U.S., using REPiS, the UPVG database, the Million Solar Roofs database, and other databases as sources (Gillette 1999).

Wind: An unpublished 1998 NREL survey of small wind turbine facilities was used for updating these facilities in REPiS (Sinclair and Forsythe 1998). Many sources were used for utility-scale wind facilities, including the American Wind Energy Association's Web site of wind projects (American Wind Energy Association 1999); the CEC list of winning bidders in the new renewable resources auction (California Energy Commission 1998); and a database of wind electric installations provided by Princeton Economic Research, Inc., of Rockville, Maryland (Princeton Economic Research 1999). For wind facilities in California, these data sources were cross-checked with data and ownership provided in biennial qualifying facility reports provided by the three California investor-owned utilities to the California Public Utilities Commission (Pacific Gas & Electric 1999; San Diego Gas & Electric 1999; Southern California Edison 1999).

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13. ABSTRACT *(Maximum 200 words)*
This technical report summarizes the data in the Renewable Electric Plant Information System (REPiS), a database of all known grid-connected renewable electric facilities in the United States. It was originally designed in 1985 and updated in 1990 and 1994. The design of the database is discussed; some of the results of common search queries of the database are summarized. Data is presented on the amount of renewable electric capacity nationally that is operated, retired, planned, or of unknown status, as well as operating and planned renewable electric capacity state by state.

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